Flight

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M. Bleriot during his 36m. 55s. flight at Issy last Saturday on his monoplane "No. XI."

MONETARY ENCOURAGEMENT OF THE INDUSTRY IN FRANCE.

WE have heard a deal during the last year or so concerning the handsome nature and the great number of the money prizes that are being offered in connection with human flight. The bulk of these have taken the form of encouraging the heavier-than-air type of machine. Many of them have been of a nature which to the expert mind is scarcely calculated to encourage the movement in the best sense possible; but there have been a great number designed on lines with which no reasonable folk can find fault. The total value of the prize money offered amounts to an enormous fortune: the total amount of prize money that has already been won does not run into five figures. The chief prizes that have been gained to date in point of cash value are those by Henry Farman and by Messrs. Wright for biplane performances; but during the past month the Institute de France has awarded the triennial Osiris Prize of the value of £4,000 to M. Gabriel Voisin, designer of what are generally known as the Farman type of biplanes, and to M. Louis Bleriot, who has made a great number of machines chiefly of the single surface type; but only this last week M. Henry Deutsch de la Meurthe has provided a capital sum of £20,000, *plus* an annual amount of £600, to found an aero-technical college in connection with the University of Paris, and this gift has been rendered even more valuable still by the simultaneous foundation of a chair of aviation by Mr. Basil Zaharoff with a donation of £28,000 more. According to the rules laid down, the Osiris Prize is intended to be a reward for the most important discovery or work in the departments of Science, Literature, and Art, or in anything that may be of conspicuous public interest; and there we have the chief significance of the award. This latest of the cash prizes to be given to experimenters in human flight—like the institution of the new French school for imparting sound instruction in the science of flight—is a far more significant matter as far as indicating the trend of public feeling and scientific opinion than even could be the offer of large cash prizes for a flight from London to Manchester and so forth.

It must be had in mind that the decision of awarding the Osiris Prize rests with a quintette of acadamies composing the Institute de France. For those bodies to have considered that any workers whatever in the field of human flight should have done such notable things as to be more worthy of reward than any other work by Frenchmen during the last three years in the departments of Science, Literature, Art, or Discovery, or in any other sphere of activity of conspicuous public interest, is something of the very utmost significance. In nearly all branches of Science, France, in common with other nations, has made great strides during the period in question. Yet here we have the collective scientific bodies of that intellectual country voting in favour of two men who have associated themselves with flying machines of the heavier-than-air type. It is as though Oxford, Cambridge, London, Edinburgh, and Dublin Universities had agreed to award a triennial cash prize of £4,000 to work which might have been done by some English investigator in the field of aerial science. At the moment, we cannot say of any one of our very many enthusiastic students that that degree of public success has accompanied their efforts which has attended those of M. Gabriel Voison and M. Louis Bleriot. It may well be, however, that even in the next twelve months aeroplanes of British design and British make will be doing flights equal to and even better than the very best that have been achieved to date by the Voisin and Bleriot machines; and there would certainly be all the greater chance of it if we, too, like France, had a M. Henry Deutsch, or at least a specially endowed college devoted to the study of aviation. As time passes so quickly in an age of multifarious activities and astounding developments, to speak of what will be done in twelve months' time is scarcely any more than to talk of what will be done next week, or a month hence. We see this even in such toilsome and necessarily slow work as Antarctic exploration, for it seems only as yesterday that Mr. Shackleton and his gallant comrades left these shores. Even at the time of their doing so they were speaking of what they had planned to do eight and twelve months ahead as though that were merely next week. If that is so when working under such adverse conditions, what must it be in scientific progress in an age when the whole civilised world is knit close together, and as it were is in touch with one branch of activity or another, irrespective of country or langauge, and wherein there are available all the resources of enthusiasm and wealth?

Wealth is a mighty factor when properly applied, and it can scarcely be applied to better advantage than in helping forward this great aerial movement. It is not given to all of us to have the physique or even the pluck to demonstrate, it is not given to all of us to have the means to encourage, but it is a privilege to have those means if we apply them to good purpose. There are a vast number of prizes waiting to be won for specific performances; but at present no generous donor has come forward with a prize on the scheme of the Osiris triennial award of £4,000, nor—even better still—with the funds to establish a school of aviation in connection with a British university. That is something had in desire in Britain. We who are interested in flight would like these things to exist if even for the chance they would offer of securing honourable recognition from our leading universities and scientific bodies for the progress already made, and to be made, in aerial navigation. Recognition from other spheres of activity than merely those which are actually and actively interested in what our experimenters and demonstrators and designers of flying machines are doing would be invaluable to progress in this country at this comparatively early stage of a new industry; and that is where our neighbours across the Channel are once more scoring so heavily. It is a little world apart this of the flying movement, but those in it are striving day by day, week by week, and month by month, year in, year out, to broaden its opinions and to bring closer that period which must ultimately and inevitably come to pass, when there will be no such section of the community as will call themselves "Aeronauts," any more than there are people who call themselves "Travellers in Railway Trains." The time will come when it will be an ordinary thing for men and women, and children, too, to fly, and in those days it will be well for the further-seeing nations of the world for whose progress in the new sphere the way had been prepared longest in advance by the influential enthusiast and the enlightened wealthy.

THE CURTISS BIPLANE.

AMERICA NOW POSSESSES ONE OF THE MOST INTERESTING FLYERS YET CONSTRUCTED; THE CURTISS BIPLANE BEING BUT LITTLE MORE THAN HALF THE WEIGHT OF THE WRIGHT MACHINE.

VERY important and very interesting developments are taking place in America, and it is every day becoming more and more evident that the wonderful success of the Wright Brothers has inspired others in the field with the most intense desire to go one better along original lines. And of these enthusiasts there is no one who has yet done more than Mr. Glenn H. Curtiss, whose latest achievement is the evolution of what bids fair to be the most successful one-man flyer which has yet been built. By a "one-man" machine, we mean a flyer which is essentially designed to carry the pilot alone, and is neither equipped nor capable of carrying a passenger. That is to say, the design of the machine and power plant have been cut down as low as it has been considered safe, in order to reduce the weight and to render possible a machine which is only a fraction of the size of those made by the Wrights and Voisin.

Comparatively few have experimented in this direction, and yet it is not only one of the most attractive sides of flying machine design, but it is also at the same time one of the most scientific, comparable in a sense to that period in motoring when the cleverest engineers in the movement were devoting their energies to the building of weight-limit racers.

The One-Man Type.

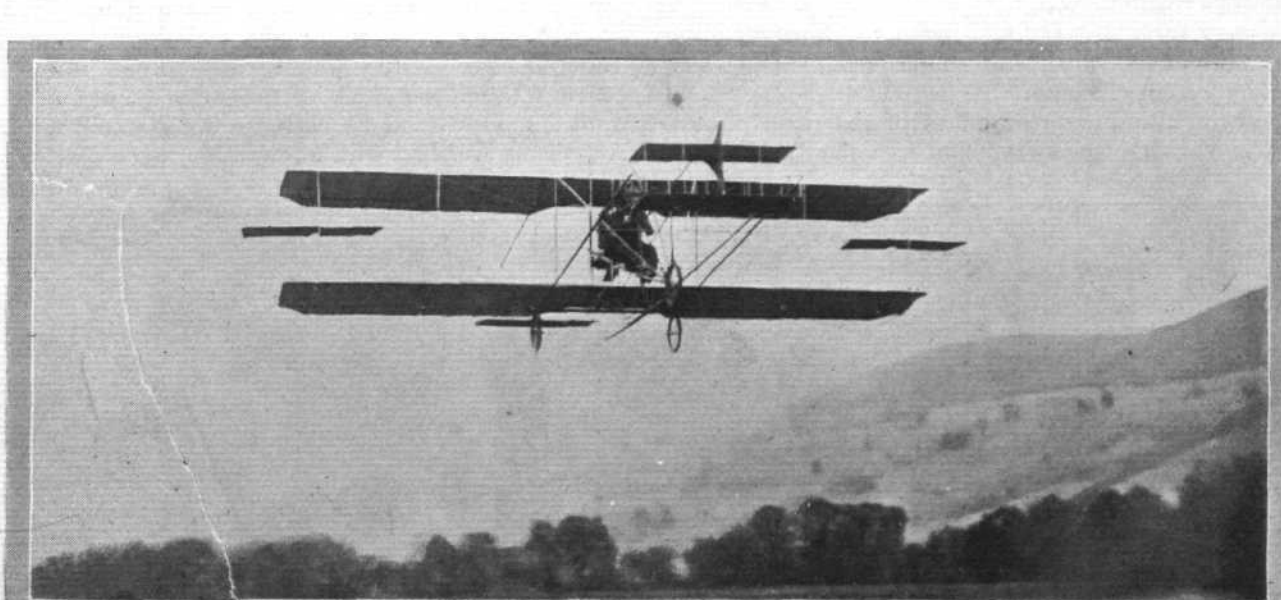
One of the keenest of sportsmen on the subject of small machines is Santos Dumont; in fact, he is a little inclined to affect the Lilliputian scale altogether, for his "Demoiselle" flyers are just a little too skimpy to be representative of a sound constructive type at the moment. In this country Mr. A. V. Roe is attempting to fly with a bicycle engine mounted on a heavier sort of machine, and it has thus been left to Mr. Curtiss in America to evolve what may be termed the first rational type of one-man machine, although even in his flyer we are of the opinion that the power plant which is said to be capable of 30-h.p. has been designed on unnecessarily generous lines, and that it might have led to a much greater achievement had the same skill been exercised in the design of an engine of but little more than half that power.

The weight of the engine itself without its accessories is only 85 lbs. The radiator, magneto, &c., add another 107 lbs., and thus bring the power plant complete up to 192 lbs., which is still considerably below anything of this power actually in successful use. It is, of course, very easy to understand why a pioneer of a new type does not want to take too many risks simultaneously, and having, as Curtiss has, cut down the supporting area of the main plane to 272 sq. ft., whereas those on the Wright flyer are about 560 sq. ft., it is perhaps not to be wondered at that he should hardly desire in the first instance to take risks also with the engine.

The Designer and His Associates.

To our readers who have followed the progress of flight in America, Mr. Curtiss' name is already well known, for it will be remembered that he was associated with the design and construction of the flyers which were built by the Aerial Experiment Association, of which Dr. Alex. Graham Bell was President. Of these machines the "June Bug" and "Silver Dart" are those which have been most successful. This association is now dissolved, but Mr. Curtiss is still associated with Mr. A. M. Herring in his designs.

Mr. Herring is a pioneer who, to the newcomers in the world of flight, is perhaps less well-known by the name than he ought to be, for it should never be forgotten that Herring commenced his flight experiences while working as assistant to the famous Chanute, whose gliders he for the most part piloted. After leaving Chanute, Mr. Herring still continued his researches, and as far back as 1897, proceeded to equip a double deck machine with an engine and propeller, with the idea of definitely achieving horizontal flight. At first he built a petrol engine, but it was not altogether successful. Then he made a compressed air engine with which he is



THE CURTISS BIPLANE IN FLIGHT.—Snapshot taken during one of the successful trial flights which Mr. Curtiss himself made at Hammondsport before handing his machine over to the Aeronautic Society at Morris Park. The photograph shows the flyer at a height of 100 feet above the ground.

reported to have acheived some short flights, and finally he built a steam engine. This was in the days before the petrol engine, as it is now known, had been evolved to the degree of perfection which has now enabled him to participate in the design of one which develops 30-h.p. in 85 lbs. weight.

It is also reported that Captain T. S. Baldwin, who made the U.S.A. Army dirigible "No I," assisted the two partners in the design of the motor.

The Owners of the Curtiss Flyer.

The present machine, which is the first that Mr. Curtiss has built since the cessation of the Aerial Experiment Association, has been constructed with a view to its being taken over by the Aeronautic Society, who will retain it for the use of members for their sport and experiment, if Mr. Curtiss performs preliminary trials with it which come up to their expectations. Already several successful flights have been made at Hammondsport, the longest being a 3-mile journey over a figure of eight course. Since then, however, the machine has been transferred to the grounds of the Aeronautic Society at Morris Park, where further trials are in progress. The price which the Aeronautic Socity have agreed to pay is $5,000.

Constructional Features.

The Curtiss flyer is a biplane having two decks spaced 5 feet apart by laminated struts, which, like the main spars, are of Oregon spruce. Each deck is 28 ft. 9 in. span, and has a chord of 4 ft. 6 in. The decks are considerably cambered, the maximum height of the curvature being about one-ninth the chord. Baldwin rubberised silk, similar to that employed in the U.S.A. Army dirigible "No. 1," is used as surfacing, and the fabric is mounted in sections, those at the outside being fastened by a system of lacing. The fabric is stretched as tight as possible, and its rigidity is augmented by spruce ribs. The decks are single surfaced, and the ribs are enclosed in pockets sewn to the upper side of the fabric. These ribs overlap the rear spar and form a flexible trailing edge, through which a wire is run for bracing purposes. When at rest on the ground the chord of the decks is inclined at an angle of about 6° to the horizon, but this does not represent the horizontal flight position. The angles of entry and trail have not been made known.

The aspect ratio, *i.e.*, ratio of span to chord, is 6·4, which is fairly high value, and should result in correspondingly good lift efficiency.

At the extremities, the rear edges of the main decks have their corners cut away, similarly in the centre, where this is done in order to accommodate the propeller. It will be observed that the main decks are in no way arched on the present machine, as they were on the earlier Curtiss designs.

Supplementary Surfaces.

Extending fore and aft to a distance of 10 ft. 6 ins. from the edges of the main decks are two triangular outrigger frames, carrying the elevator and tail.

The elevator consists of a pivoted biplane of 6 ft. span by 2 ft. chord, and having an area, therefore, of 24 sq. ft., or less than one-eleventh of the total area. This is a smaller ratio than exists in the large machines.

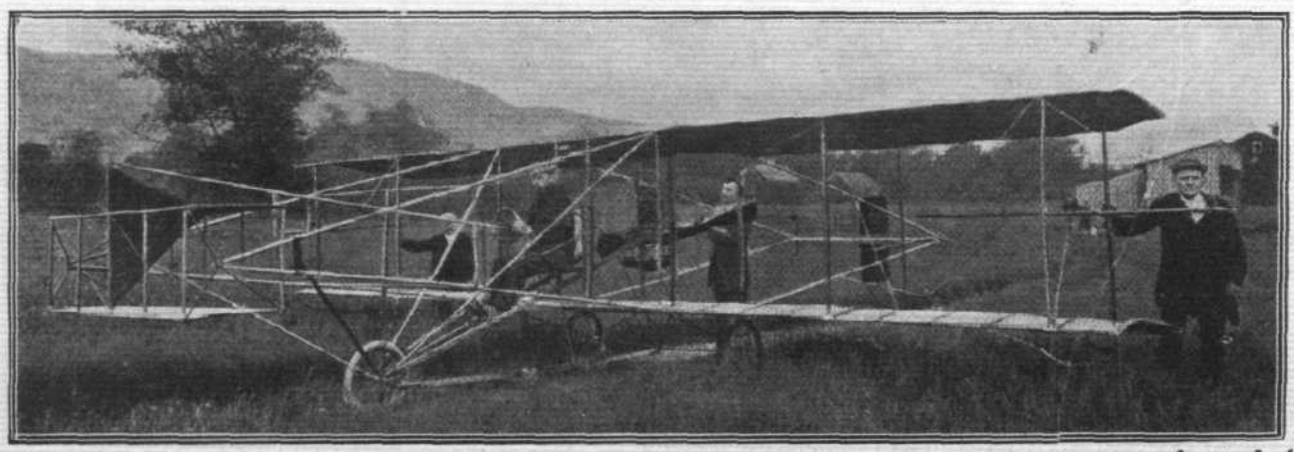
Between the decks of the elevator, and also extending a little above the top deck, is a triangular prow, which serves the purpose of a cutwater to give sensitiveness to direction.

On the other outrigger which extends rearwards, is a horizontal tail of 12 sq. ft., and a vertical rudder of $6\frac{1}{4}$ sq. ft. area divided into two parts so that it is symmetrical above and below the tail.

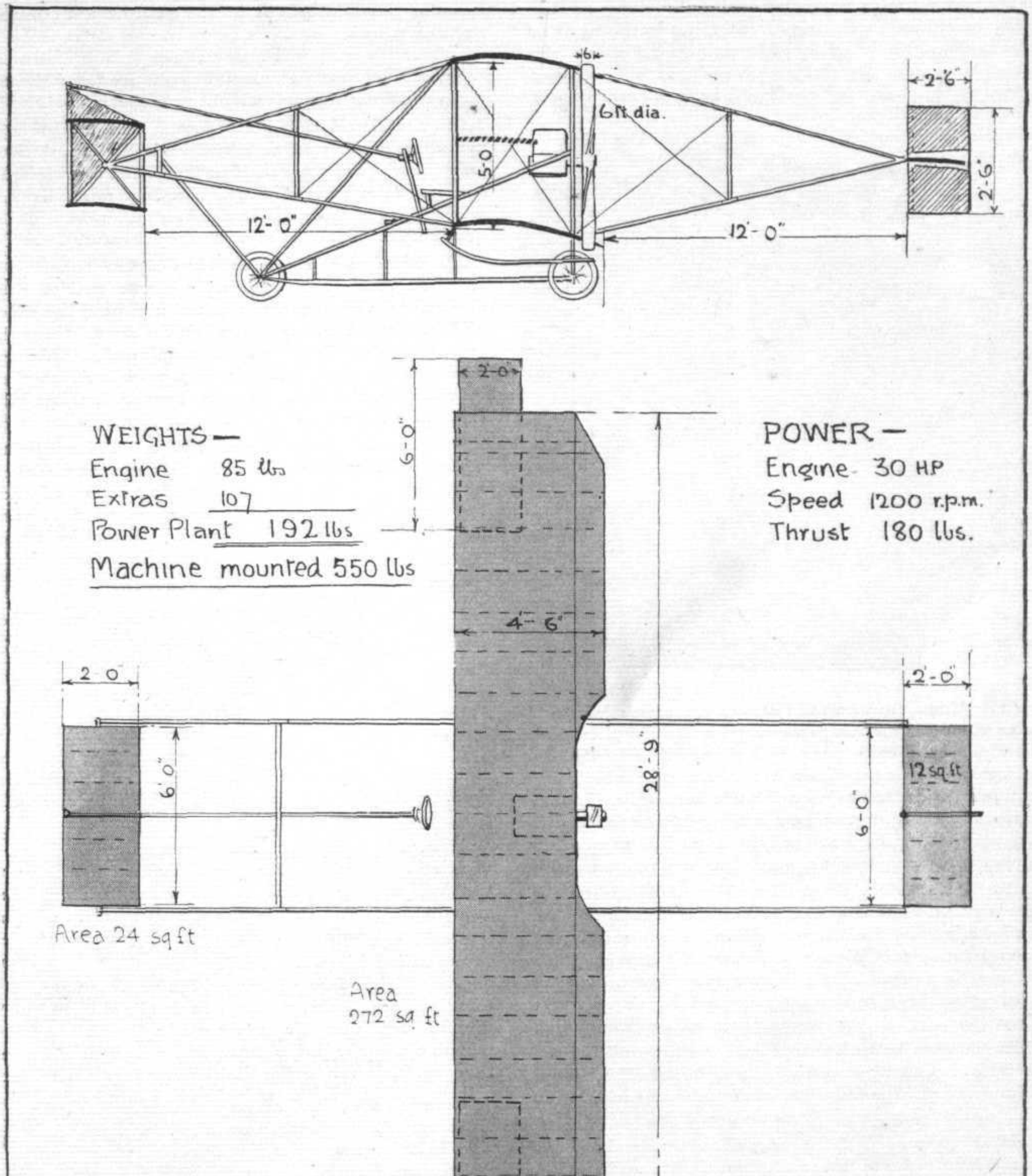
In addition to these supplementary surfaces, there are two others situated between the extremities of the main decks, where they serve the same purpose as is performed by warping on the Wright machine. These balancing planes, as they may be called, have each the same dimensions (2 ft. by 6 ft.) as the decks of the elevator and tail, and it will be noticed on reference to our drawing that they extend some little distance beyond the extremities of the main planes, although the greater part of their area is between decks. This feature we consider to be of very considerable importance on the score that it is questionable practice to put supplementary planes of this description between the main decks, both because it tends to throttle the gap and thereby possibly interfere with the lift efficiency, while conversely the decks themselves may be expected to have a restricting influence on the action of the righting planes when they are tilted or dipped. The fact that a portion of the righting planes on the Curtiss flyer are quite outside the extremities of the main planes is therefore a detail which should not be overlooked.

The Chassis.

The machine as a whole is mounted upon a three-wheeled chassis, of which the framework is made of wood. Two of the wheels are placed immediately beneath the lower deck of the main planes, while the third is mounted on an outrigger some distance in front. All wheels are shod with 20-in. diam. pneumatic tyres.



THE CURTISS BIPLANE.—General view of the machine on terra firma, showing the elevator in front of the main decks. The camber of the decks is particularly well shown in this view, which should be compared with the drawing.

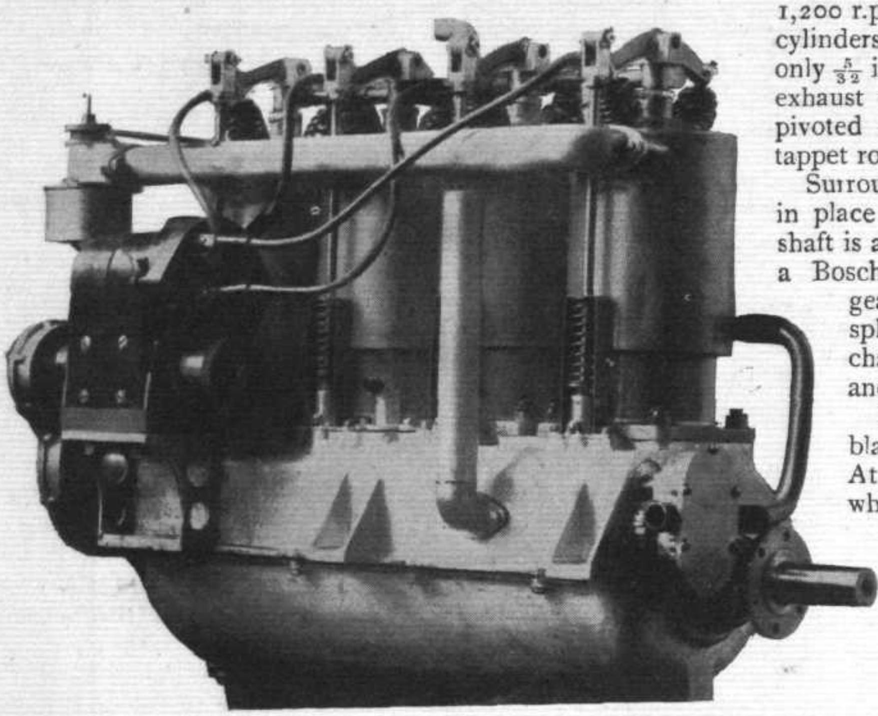


CURTISS BIPLANE.—Elevation and plan showing the leading constructional features and dimensions of the Curtiss biplane, which has been made in America by Mr. Glenn H. Curtiss in conjunction with Mr. A. M. Herring. It should be noted that the weight of the machine mounted is only 550 lbs., and that it is fitted with a particularly light engine. Instead of warping the main decks as on the Wright machine, lateral control is obtained by independent balancing planes.

Control.

The system of control on the Curtiss biplane is naturally much the same in its essential features as that on other machines of the type. Steering to the right or left is accomplished by a joint manipulation of the righting planes and the rudder, which may be employed either in the same or in opposite senses, according as it is required to increase or minimise the cant. Longitudinal oscillations are damped out by the elevator, and any tendency to capsize is checked by using the balancing planes. Ascent and descent automatically accompany variations in engine power, although the elevator can be used as a means of producing temporary jumps for adjusting the line of flight.

The operating mechanism by means of which the pilot is enabled to perform these various manœuvres, consists of a steering wheel and a lever formed by the pivoted back of his seat, which has extensions embracing his shoulders so that it can be operated by a swaying motion of his body. The steering wheel is mounted on a sliding shaft, and is pulled and pushed bodily to and fro for the purpose of tilting and dipping the elevator. Turning the steering wheel upon its axis operates the rudder, and swaying the pilot's body to the right or left controls the righting planes.



THE CURTISS AERO-MOTOR.—General view of the 4-cyl. Curtiss engine used on the Curtiss biplane. The cylinders are $\frac{5}{32}$-in. thick, and have copper jackets. The weight, without magneto, is 85 lbs.

Power Plant.

Some mention has already been made of the engine, the power capacity of which is stated to be 30-h.p. at 1,200 r.p.m. It is a petrol motor of the 4-cyl. type, the cylinders being cast separately, and with a thickness of only $\frac{5}{32}$ in. Set diagonally in the heads are the inlet and exhaust valves, both of which are operated by a single pivoted rock lever, controlled from a double acting tappet rod.

Surrounding the cylinders are copper-jackets fastened in place with welded joints. On one end of the cam-shaft is a gear wheel water pump and from the other end a Bosch high-tension magneto is driven through spur gearing. In the centre an oil pump is driven, but splash lubrication is also provided in the crank chamber. The radiator carries 2 gallons of water and the fuel tank $2\frac{1}{2}$ gallons of petrol.

Direct coupled to the crank-shaft is a two-bladed propeller 6 ft. in diameter and 6 ft. pitch. At 1,200 r.p.m. it develops a thrust of 180 lbs., which is considerably in excess (it is conceivably twice as much) of that required for horizontal flight.

Materials.

Timber is employed throughout in the construction of the Curtiss biplane, and for the most part the selected wood is Oregon spruce, although it is a feature of the details that some parts of the elevator and tail are made of bamboo. The main spars and ribs of the main deck are of spruce, and the propeller is also of this material. The surfacing consists, as mentioned elsewhere, of Baldwin rubberised silk.

Weights and Dimensions.

All the principal dimensions, together with the leading weights, will be found on the accompanying drawing, and some have already been referred to in the text above. The engine alone weighs 85 lbs., the magneto $12\frac{1}{2}$ lbs., the radiator 40 lbs. Altogether the accessories bring the engine weight up to 192 lbs. The weight of the machine mounted is 550 lbs., so that as a glider it would weigh mounted 358 lbs., and allowing 170 lbs. for the pilot, the machine alone comes out at 188 lbs., which is an amount that ought to have given the constructors a fair chance of making a sound strong job of their work.

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FRANKFORT EXHIBITION.

ON Saturday next, the Aeronautical Exhibition will open at Frankfort, and remain open until October 10th. In view of the greater attention which has been paid in Germany to the development of lighter-than-air craft, it will be hardly surprising that exhibits relating to this type predominate, and it is promised that several complete dirigibles will be on view. The aeroplane side will, however, not be neglected, and a full and comprehensive display of models and photographs of the most successful machines will be included. A feature of the Exhibition will be the daily trips which it is proposed to make by dirigible balloons to various places round about Frankfort.

PEACE IN AUSTRIA.

IN order to settle all question as to the controlling of aeronautical competitions in Austria, a Commission, on the lines of the French Commission Aerienne Mixte, representing the Viennese Aero Club, the Austrian Automobile Club, and the Austrian Technical Aeroplane Society, has been formed. Each body will elect three delegates to this Commission, and in addition the President of the Viennese Aero Club will be *ex-officio* Chairman. The Viennese Aero Club is the body internationally recognised, and they retain the sole control of all balloon competitions. All other aeronautical matters will be referred to the consideration of the Austrian Aeronautic Commission.

PROPELLER MATHEMATICS FOR NOVICES.*

By JOHN SQUIRES, M.E., Chief of Physical Laboratory, E. R. Thomas Motor Co.

To begin with, I am obliged to comment upon the danger of giving data on propellers, which same holds good with aeronautical data in general, because of the peculiarly hazardous risks involved, without explaining the method by which the data was attained, unless offered by someone whose past performance is a guarantee of his being in the right, as otherwise the amateur has nothing to check against, and perforce, being compelled to accept it as gospel if he uses it at all. His apparatus goes or stays in due proportion to the amount of misinformation built into it.

The above is intended, not as a diatribe, but merely as a warning to the amateur, as the expert is bound to offer such data as he has been able to accumulate either by experiment or hard knocks, and the editor plays his part in full in bringing it to the attention of readers. If the method used is explained, one can usually determine for himself as to whether the data ought to be accurate or not.

In the present article, however, it is only my intention to lay down the effects of the four purely mathematical variants involved in propeller design, all of which effects can be demonstrated by calculation and without mechanical experiment.

I may say that I have verified all the conclusions set forth below by actual experiment; a great many propellers having been built as well as the necessary apparatus to test them.

It is well to state at this point that there are two distinct types of propellers, only one of which will be dealt with here, and for the present purpose we will consider them as delivering their work in slip, that is, not moving through the air, but delivering their thrust at a fixed, immovable point.

One of these types produces thrust by moving its blades as nearly as possible over undisturbed air, and we will call this the "gliding-blade type." The other, however, exerts its work in moving the greatest possible area of air, at a velocity corresponding to its pitch and speed of revolution, thus getting its effect as though the thrust were accomplished by the effect of air blowing against the propeller, and we will call this the "air-moving type."

Obviously the gliding principle of the first type demands it to be of large diameter, which again causes it to be frail in proportion to the work required of it, if weight is to be avoided, and the very fact of its being designed for undisturbed air places it at a disadvantage in rough weather. The air-moving type, however, can be built small, compact, is easily applied, and can be built very strong without greatly added weight, and this is the type which is considered mathematically in this article.

In my early experiments I, of course, did not know which was the best type of propeller, and was consequently put to many pains to try the various types designed by other experimenters. Some I found extremely deficient and others good. That is, it is possible to measure a propeller and tell under what conditions it will do its best work, and from these good ones gradually began to develop the laws governing the design of a propeller for theoretically perfect efficiency.

(A) For instance, it is possible to design a propeller which will exert its work throughout the whole area swept through by the blades.

Consequently, perfect efficiency is the effect of air blowing against this area at a uniform velocity throughout, equal to the pitch speed of the propeller, and minus the head resistance and surface friction of the hub and blades.

Of course, as my data began to accumulate some formulæ increased in accuracy and some had to be discarded altogether, and many entirely new ones were obtained, until in the last propellers built and tested remarkably high efficiencies became the rule.

Owing to the surprising effect that a change in some of the variants produce, I have thought it well, as stated above, to explain the principles governing these mathematical variants, for the reason that the whole design of the propeller, cross-section, and outline shapes of blades, the number of blades, &c., is so different between a design for low speed of revolution and one for high that it is extremely difficult for a person even fairly familiar with propellers to believe that both will do the same work with the same efficiency.

(B) Let me say here that there is no standard cross-sectional shape nor type of blade as regards normal projected shape, that is equally efficient under more than moderately diversified working conditions.

Consequently, as stated in (A), it being possible to get full swept-area propulsive effect, this is only true with blades of the correct cross-sectional and normal projected shapes, and (C) with a sufficient number of blades.

If in plotting the thrust-curve the thrust units be considered as abscissae and the blade units as ordinates, it is evident that as more blades are added the line becomes horizontal, and when this condition is reached, a sufficient number of blades is indicated, and more would only serve to use up power in blade surface friction, and it is at this point that we begin to obtain data on blade surface friction.

Knowing that it is possible to get full swept-area propulsive effect, the proportional value of the four purely mathematical variants which affect the work output and power consumption must be intelligently determined before it is possible to make even a rational guess as to what is required as a whole.

The value of the first of these is usually determined by outside conditions: such, for instance, as weight, and is the power at command; and the second, which hinges on the first, is the speed of revolution. Then comes the area, which is largely governed by construction conditions, and last comes pitch, which necessarily, under the above circumstances, is somewhat at the mercy of the other three, although equally important with the speed of revolution, owing to the fact of pressure caused by moving air varying with the square of velocity (V^2).

Thus it will be seen that variations of either the speed of revolution or the pitch is bound to vary the work with the third power, or cube, because each of these is a second power, or square, to begin with.

Therefore, it is my intention to lay down the effect of each of these variants in the abstract, as though they were purely selective, and show the effects of varying each of them singly as well as in combination with variations of the other three, in relation to the effect on power, and on the thrust per unit of power, which is the

* From American *Aeronautics*.

particularly essential result for which a propeller is designed.

Reasoning in the abstract, it is presumptive that the power can be varied at will. So in the following table of effects it will be left as a corollary to the other variations; and presuming that we already have a standard propeller, we will begin with alterations of the speed of revolution, always keeping in mind the V^2 law.

My excuse for setting down the whole list of changes is that we will have them directly under our eye, where it is usually easier to scan them than in the mind.

In all cases where speed is mentioned in the table, speed of revolution is meant.

1. Doubling the speed without altering the pitch or area, alters (increases) the power with the cube of the speed, and alters (decreases) the thrust per unit of power inversely with the speed.

2. Doubling the speed and halving the area without altering the pitch, alters the power with both the speed and area, increasing it with the cube of the speed and decreasing it directly with the area, which is practically equal to altering (increasing) it with the square of the speed, and alters (decreases) the thrust per unit of power inversely with the speed.

3. Doubling the speed and halving the pitch without changing the area alters neither the power nor the thrust per unit of power.

4. Doubling the area without altering the speed or the pitch alters (increases) the power directly with the area, and does not alter the thrust per unit of power.

5. Doubling the area and halving the speed without altering the pitch alters the power with both the area and the speed, increasing it directly with the area, and decreasing it with the cube of the speed, which is practically equal to altering (decreasing) it inversely with the square of the speed, and alters (increases) the thrust per unit of power inversely with the speed.

6. Doubling the area and halving the pitch without altering the speed alters the power with both the area and pitch, increasing it with the area and decreasing it with the cube of the pitch, which is practically equal to altering (decreasing) it inversely with the square of the speed, and alters (increases) the thrust per unit of power inversely with the pitch.

7. Doubling the pitch without altering the speed or area alters (increases) the power with the cube of the pitch, and alters (decreases) the thrust per unit of power inversely with the pitch.

8. Doubling the pitch and halving the speed without altering the area does not alter the power thrust per unit of power.

9. Doubling the pitch and halving the area without altering the speed alters the power with both the pitch and the area, increasing it with the cube of the pitch and decreasing it directly with the area, which is practically equal to altering (increasing) it with the square of the pitch, and alters (decreases) the thrust per unit of power inversely with the pitch.

10. Doubling the speed and doubling the area without altering the pitch alters (increases) the power with the cube of the speed, and also directly with the area, which is practically equal to altering (increasing) it with the fourth power of the speed, and alters (decreases) the thrust per unit of power inversely with the speed.

11. Doubling the speed and doubling the area, and halving the pitch, alters (increases) the power with the cube of the speed, and also directly with the area, but also decreases it with the cube of the pitch, which is practically equal to altering it (increasing) directly with the area, and does not alter the thrust per unit of power.

12. Doubling the speed and doubling the pitch without altering the area alters (increases) the power with the cube of the speed, and also with the cube of the pitch, which is practically equal to increasing it with the sixth power of the speed, and alters (decreases) the thrust per unit of power inversely with the square of the speed.

13. Doubling the speed and doubling the pitch, and halving the area, alters (increases) the power with the cube of the speed, and with the cube of the pitch, but also alters (decreases) it inversely with the area, which is practically equal to increasing it with the fifth power of the speed, and alters (decreases) the thrust per unit of power inversely with the square of the speed.

14. Doubling the area and doubling the pitch without altering the speed alters (increases) the power directly with the area and also with the cube of the pitch, which is practically equal to increasing it with the fourth power of the pitch, and alters (decreases) the thrust per unit of horse-power inversely with the pitch.

15. Doubling the area and doubling the pitch, and halving the speed, alters (increases) the power directly with the area, and also with the cube of the pitch, but also alters (decreases) it inversely with the cube of the speed, which is practically equal to increasing it directly with the area, and does not alter the thrust per unit of power.

16. Doubling the speed and doubling the area, and doubling the pitch, alters (increases) the power with the cube of the speed, and also directly with the area, and also with the cube of the pitch, which is practically equal to increasing it with the seventh power of either the speed or the pitch, and alters (decreases) the thrust per unit of power inversely with the square of the speed.

I have neglected to set down in the table such combinations as have two or more decreasing members, as the effect of these is merely opposite to similar combinations with increasing members.

Now, scanning back over the table, it is perfectly easy to see where the greatest economy of change lays.

Take cases 5 and 6, which are exactly alike as far as effect of change is concerned, but of which 6 is the most practical because of allowing the motor to be run at the same speed, it is found that the change has cut the power to one-fourth of what it was and has doubled the thrust per unit of power.

In other words, suppose a 20-h.p. motor giving a thrust of 20 lbs. per horse-power, or 400 lbs. total thrust, then by doubling the area and halving the pitch, the power consumed is reduced to 5-h.p., and the thrust per horse-power is increased to 40 lbs., or a total thrust of 200 lbs.

Now, reasoning further, we see from case 4 that increasing the area only increases the power directly with the area, and does not alter the thrust per horse-power. Consequently, multiplying the area again by four brings the horse-power back to the original 20, and a thrust of 40 lbs. per horse-power gives a total thrust of 800 lbs., or double the original total thrust.

At this point it is to be recalled to mind that the propeller under consideration is exerting propulsive effect throughout the area swept by the blades. Therefore, let this area be considered as a normal disc, which is very nearly true in practice with a correctly designed propeller, and it will be seen that while the area has been increased five times, the diameter has only been

increased two and one-quarter times, due to the law that the area included in a circle increases with the square of the diameter.

It is not necessary to carry the discussion on effects further, as it should be quite possible from the table to deduce which particular combination would be the most suitable under given circumstances, and I think it shows quite fully in what direction the best economy of power lays.

One point in particular which the table brings out very forcibly is the great variation in thrust per unit of power which is possible with propellers of equal efficiency, as witness cases 5 and 6, where the thrust per unit of power is doubled, and cases 12 and 13, where the thrust per unit of power is quartered, thus giving conditions under which (D) one propeller could have a thrust per unit of power eight times that of another, even if both of them were of 100 per cent. efficiency.

To avoid misleading the reader, I wish to point to the danger of misapplying the above table of effects. Please do not confuse area and diameter. For instance, there is not an aerial propeller in service to-day that gives swept-area propulsive effect, some giving slightly more than blade-area effect and others giving less than blade-area effect, due to bad design. Consequently, when this is the case, the table does not hold, and diameter must be considered instead of area.

This particular kind of bad design carries more than its own penalty with it, in that the necessity for increasing the size of the propeller with the diameter rather than with the area, increases the amount of centrifugal force involved in two ways, both from the necessary additional material to get the surface required and the additional strengthening of the cross-section to withstand the strain.

In conclusion, I wish to emphasise again the four points which I have tried to bring most strongly to the reader's attention :—

A. That it is possible to design propellers which will give swept-area propulsive effect.

B. That there is no universally efficient cross-sectional and normal projected shapes of blade.

C. That the number of blades varies with the working conditions.

D. That propellers of equal efficiencies can deliver widely different thrusts per unit of power.

In the course of my experiments I built and tested propellers from the data of Langley, Maxim, Phillips, Herring, Hollands, Turnbull, and others less well known, but latterly, of course, from the very nature of the developments, the types varied according to the working conditions and the designs were governed entirely thereby.

In this article I have carefully refrained from giving any actual experimental data, but have endeavoured rather to stick to the purely mathematical principles involved, and would further call to the attention that I have not dealt with propellers in flight, preferring to take this up separately and to show as a sequence, again, that a higher thrust per horse-power does not, of itself, mean higher efficiency, and that because a propeller has high thrust per horse-power against a fixed point, it does not follow that the machine to which it is attached will travel faster through the air than one with a lower thrust per horse-power.

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SOARING FLIGHT—HOW TO PERFORM IT.

By O. CHANUTE. (*Concluded from page 385.*)

THE most difficult case is purposely selected. For if we assume that the bird has previously acquired an initial minimum speed of 17 miles an hour (24·93 feet per second, nearly the lowest measured), and that the air was rising vertically 6 miles an hour (8·80 feet per second), then we have as the trend of the "relative wind" encountered : $\frac{6}{17} = 0{\cdot}353$, or the tangent of 19° 26′ which brings the case into the category of rising wind effects. But the bird was observed to have a negative angle to the horizon of about 3°, as near as could be guessed, so that its angle of incidence to the "relative wind" was reduced to 16° 26′.

The relative speed of its soaring was therefore :

$$\text{Velocity} = \sqrt{17^2 + 6^2} = 18{\cdot}03 \text{ m.p.h.}$$

At this speed, using the Langley co-efficient recently practically confirmed by the accurate experiments of Mr. Eiffel, the air pressure would be :

$$18{\cdot}03^2 \times 0{\cdot}00327 = 1{\cdot}063 \text{ lbs. per sq. ft.}$$

If we apply Lilienthal's co-efficients for an angle of 16° 26′, we have for the force in action :

Normal : $4{\cdot}57 \times 1{\cdot}063 \times 0{\cdot}912 = 4{\cdot}42$ lbs.

Tangential : $4{\cdot}57 \times 1{\cdot}063 \times 0{\cdot}074 = -\ 0{\cdot}359$ lbs.

Which latter, being negative, is a propelling force.

Thus we have a bird weighing 4·25 lbs. not only thoroughly supported, but impelled forward by a force of 0·359 lbs., at 17 m.p.h., while the experiments of Professor A. F. Zahm showed that the resistance at 15·52 m.p.h. was only 0·27 lbs., or

$$0{\cdot}27 \times \frac{17^2}{15{\cdot}52^2} = 0{\cdot}324 \text{ lbs., at 17 miles an hour.}$$

These are astonishing results from the data obtained, and they lead to the inquiry whether the energy of the rising air is sufficient to make up the losses which occur by reason of the resistance and friction of the bird's body and wings, which, being rounded, do not encounter air pressures in proportion to their maximum cross-section.

We have no accurate data upon the co-efficients to apply, and estimates made by myself proved to be much smaller than the 0·27 lbs. resistance measured by Professor Zahm, so that we will figure with the latter as modified. As the speed is 17 miles per hour, or 24·93 ft. per sec., we have for the work :

Work done, $0{\cdot}324 \times 24{\cdot}93 = 8{\cdot}07$ ft.-lbs. per sec.

Corresponding energy of rising air is not sufficient at 4 m.p h. This amounts to but 2·10 ft.-lbs. per sec., but if we assume that the air was rising at the rate of 7 m.p.h. (10·26 ft. per sec.), at which the pressure with the Langley co-efficient would be 0·16 lbs. per sq. ft., we have on 4·57 sq. ft. for energy of rising air :

$$4{\cdot}57 \times 0{\cdot}16 \times 10{\cdot}26 = 7{\cdot}50 \text{ ft.-lbs. per sec.,}$$

which is seen to be still a little too small, but well within the limits of error, in view of the hollow shape of the bird's wings, which receive greater pressure than the flat planes experimented upon by Langley.

These computations were chiefly made in January, 1899, and were communicated to a few friends, who found no fallacy in them, but thought that few aviators would understand them if published. They were then submitted to Professor C. F. Marvin, of the Weather Bureau, who is well known as a skilful physicist and mathematician. He wrote that they were, theoretically,

entirely sound and quantitatively, probably, as accurate as the present state of the measurements of wind pressures permitted. The writer determined, however, to withhold publications until the feat of soaring flight had been performed by man, partly because he believed that, to ensure safety, it would be necessary that the machine should be equipped with a motor in order to supplement any deficiency in wind force.

The feat would have been attempted in 1902 by Wright Brothers if the local circumstances had been more favourable. They were experimenting on "Kill Devil Hill," near Kitty Hawk, N.C. This sand hill, about 100 ft. high, is bordered by a smooth beach on the side whence come the sea breezes, but has marshy ground at the back. Wright Brothers were apprehensive that if they rose on the ascending current of air at the front and began to circle like the birds, they might be carried by the descending current past the back of the hill and land in the marsh. Their gliding machine offered no greater head resistance in proportion than the buzzard, and their gliding angles of descent are practically as favourable, but the birds performed higher up in the air than they.

Professor Langley said in concluding his paper upon "The Internal Work of the Wind":

"The final application of these principles to the art of aerodromics seems, then, to be that while it is not likely that the perfect aerodrome will ever be able to dispense altogether with the ability to rely at intervals on some internal source of power, it will not be indispensable that this aerodrome of the future shall, in order to go any distance—even to circumnavigate the globe without alighting—need to carry a weight of fuel which would enable it to perform this journey under conditions analogous to those of a steamship, but that the fuel and weight need only be such as to enable it to take care of itself in exceptional moments of calm."

Now that dynamic flying machines have been evolved and are being brought under control, it seems to be worth while to make these computations and the succeeding explanations known, so that some bold man will attempt the feat of soaring like a bird. The theory underlying the performance in a rising wind is not new, it has been suggested by Penaud and others, but it has attracted little attention, because the exact data and the manœuvres required were not known and the feat had not yet been performed by a man. The puzzle has always been to account for the observed act in very light winds, and it is hoped that by the present selection of the most difficult case to explain—*i.e.*, the soaring in a dead horizontal calm—somebody will attempt the exploit.

The following are deemed to be the requisites and manœuvres to master the secrets of soaring flight:—

1st. Develop a dynamic flying machine weighing about 1 lb. per sq. ft. of area, with stable equilibrium and under perfect control, capable of gliding by gravity at angles of 1 in 10 ($5\frac{3}{4}^\circ$) in still air.

2nd. Select locations where soaring birds abound, and occasions where rising trends of gentle winds are frequent and to be relied on.

3rd. Obtain an initial velocity of at least 25 ft. per sec. before attempting to soar.

4th. So locate the centre of gravity that the apparatus shall assume a negative angle, fore and aft, of about 3°. Calculations show, however, that sufficient propelling force may still exist at 0°, but disappears entirely at $+ 4^\circ$.

5th. Circle like the bird. Simultaneously with the steering, incline the apparatus to the side toward which it is desired to turn, so that the centrifugal force shall be balanced by the centripetal force. The amount of the required inclination depends upon the speed and on the radius of the circle swept over.

6th. Rise spirally like the bird. Steer with the horizontal rudder, so as to descend slightly when going with the wind and to ascend when going against the wind. The bird circles over one spot because the rising trends of wind are generally confined to small areas or local chimneys, as pointed out by Sir H. Maxim and others.

7th. Once altitude is gained, progress may be made in any direction by gliding downward by gravity.

The bird's flying apparatus and skill are as yet indefinitely superior to those of man, but there are indications that within a few years the latter may evolve more accurately proportioned apparatus and obtain absolute control over it.

It is hoped, therefore, that if there be found no radical error in the above computations, they will carry the conviction that soaring flight is not inaccessible to man, as it promises great economies of motive power in favourable localities of rising winds.

The writer will be grateful to experts who may point out any mistake committed in data or calculations, and will furnish additional information to any aviator who may wish to attempt the feat of soaring.

THE VALUE OF MODEL FLYER CLUBS.

AN altogether admirable move has been made towards the establishment of clubs for the encouragement of sport with model flyers in various parts of the country, the first town to take the matter up being Blackpool, where Mr. J. Kemp, of Cookson Street, is inviting other enthusiasts to join with him in establishing a club of this character. The idea is to stimulate interest in the subject of aviation, and to induce a practical interest in the building of models, not only by the inauguration of exhibitions from time to time, but also by the institution of competitions at frequent intervals. Such clubs as these could do a very great deal of useful work in preparing the way for the new era that is assuredly coming, not only by popularising the idea of human flight amongst the general public, but also by instilling a fair amount of specific knowledge on the subject into the minds of the younger members of the community. Particularly in the larger seaside towns, and also in other well-populated districts where facilities exist for competitions between machines of all types and size, model flyer clubs have plenty of good work and a very enjoyable time before them. This is a development of which we spoke in our leading article of May 1st, at the time when Mr. V. E. Johnson suggested the substitution of model flyers—with their seashore contests—for diabolo as *the* juvenile sport for this summer. Mr. Johnson then offered, it will be remembered, to start the ball rolling in the matter of prizes, by giving one for the best flight made by a model constructed by any schoolboy of strictly British nationality.

News of the Week.

Aerial Volunteers.

In view of the great interest which is at present being taken in flight matters, it is perhaps hardly to be wondered at that an announcement is again being made that the War Office are seriously considering the formation of an Aerial Reserve, on similar lines to the Army Motor Reserve. Although there hardly appears to be a sufficient number of successful flyers, either men or machines, in this country from which to recruit such a corps, there is no doubt that those who own practical machines would be ready to loan them to the nation at a time of emergency, and in fact several of them have already promised to do so.

Cross-Channel Flying.

Mr. Latham's recent record flight, and his avowed intention of making an early attempt to win the *Daily Mail* cross-Channel prize, seems to have urged some of the other prominent aviators in France to take some steps with a view to anticipating him. On Sunday, Mr. Henry Farman arrived at Boulogne, and is said to have stated that he intended to make the trip within ten days; while Comte Lambert has secured ground at Wissart, just by Cape Grisnez, on which to erect an aeroplane shed. Mr. Farman thinks Sangatte, between Calais and Grisnez, the best place from which to start.

On Sunday last Mr. Latham was in England prospecting for a landing place, and came to the conclusion that, if possible, he would make for the top of Shakespeare Cliff. Otherwise he would land on the Folkestone side of Dover Harbour. He will probably start in a week's time from Cape Blanc Nez, a high chalk cliff a few miles from Calais. French torpedo boats will be in the Channel in case of emergency, and there will also probably be some members of the B.M.B.C. on the look out with their fast motor boats.

Bleriot Makes a Big Advance.

In view of the long time he has been experimenting, and the number of machines he has built, it is a little difficult to comprehend that M. Bleriot's longest flight was the cross-country one of last year, which only lasted for 11 minutes. By his splendid performances during last week-end, he has shown that his baby monoplane, "No. XI," is capable of staying aloft for long periods. On Friday evening, at Issy, M. Bleriot mounted his machine, and in spite of a strong wind blowing, succeeded in making eleven circuits of the big parade ground, the time occupied being 15 mins. 30 secs. Needless to say, on making a perfect landing after this trip M. Bleriot was accorded an ovation by the few enthusiasts who had stayed behind to see the finish. On Saturday last MM. Archdeacon, Chanvière, Zens, and A. Fournier were present on the ground on behalf of the Aero Club, and at 7 o'clock M. Bleriot started for another long flight. He flew for 36 mins. $55\frac{3}{5}$ secs., and could have continued but for the fact that owing to over-lubrication the engine commenced miss-firing. M. Bleriot therefore cut off the ignition, and came to earth. It was a pity that automatic lubrication was not installed, for the intrepid aviator had no doubt that, but for the miss-firing, he could have kept going for over an hour. Otherwise the three-cylinder Anzani engine was working perfectly. M. Bleriot is now at Douai with his "No. 12" monoplane. On Monday he flew for $2\frac{1}{2}$ kiloms. at a height of 20 metres, and on the following day he carried a passenger over the full circuit of the Brayelle aerodrome.

Others at Issy.

One of the latest arrivals at Issy is M. Paulhan and his Voisin biplane, with which he made several short flights of about 200 metres or so on Monday. A peculiarity of the machine is that M. Paulhan has had a fifth wheel fitted underneath the end of the girder which carries the elevating plane. It is fitted with a 6-cyl. 50-h p. Gnome engine, the cylinders of which rotate with the propeller. Another arrival at Issy is M. Delagrange, who is making himself thoroughly acquainted with the R.E.P. flyer, with which he is to make flights in Spain for M. Sanchis, the owner of the machine.

Mr. Henry Farman Flies for 20 Mins.

On Monday evening, at Chalons, Mr. Henry Farman made his first long flight with his new machine, remaining in the air for a little over 21 mins.

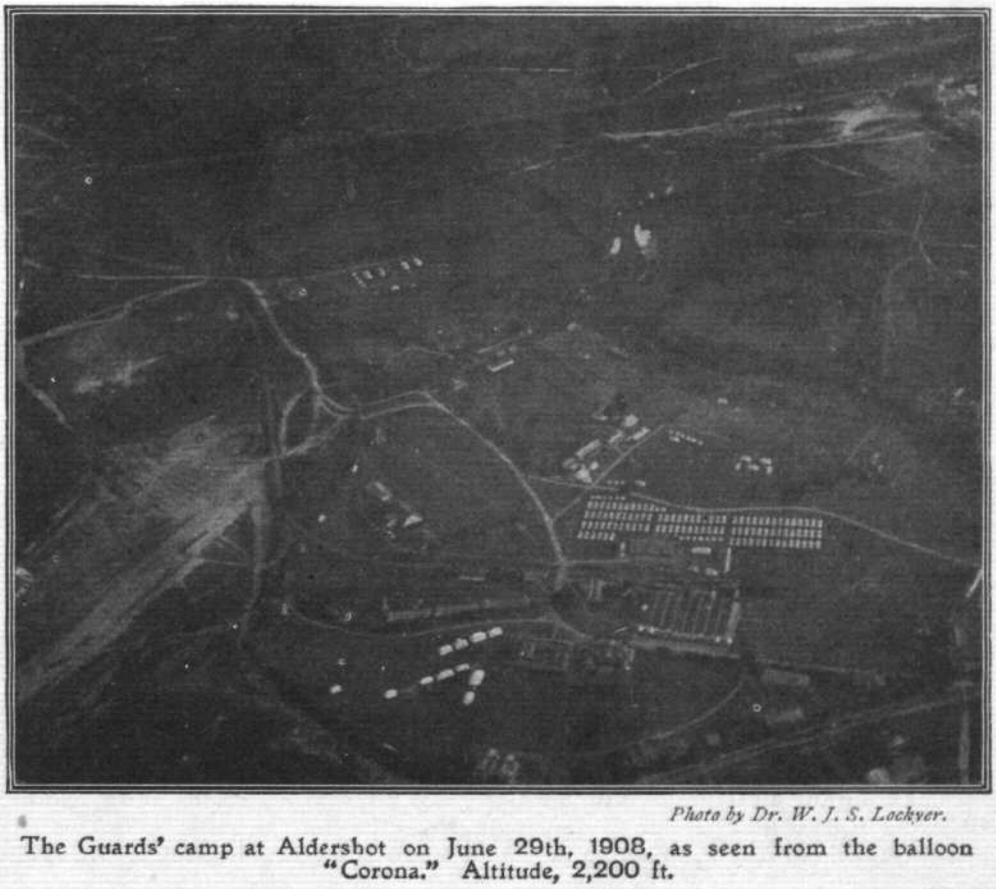


Photo by Dr. W. J. S. Lockyer.

The Guards' camp at Aldershot on June 29th, 1908, as seen from the balloon "Corona." Altitude, 2,200 ft.

Comte Lambert in Holland.

After having set his mechanics to work at Wissart, erecting the Wright flyer with which he intends to cross the Channel, Comte Lambert left for Holland in order to keep an engagement there to make some demonstration flights in that country. On Sunday last he was at Essen, close to Breda, and made several flights over a circular kilom., the trials being witnessed by a large crowd of people.

At Douai.

In addition to M. Bleriot, who is the "star turn" at the Brayelle aerodrome at Douai just now, M. Breguet has a biplane there and has made one or two short "hops."

Another Successful Flyer.

Yet another has been added to the ranks of the successful aviators by M. Jean Gobron, a son of the Ardennes Senator, who on Saturday last at Chalons made a remarkable performance at Issy by flying on his Breguet biplane for a distance of 15 kiloms., and on Tuesday last he flew for a distance of 10 kiloms. at a speed of about 70 kiloms. per hour.

Accident to the Ogier Biplane.

After making one or two short flights or jumps of about 150 metres on Sunday, at Issy, M. Ogier had a mishap with the biplane which has been built for him by MM. Regis Freres. While at a height of several metres, the longitudinal stability of the machine was upset and it pitched forward, damaging the motor and propeller, as well as the main planes.

Familiarity Breeds Contempt.

That the old proverb will apply to aviators as to other classes of men there is not the least doubt, and an instance was forthcoming at Port Aviation last Sunday. It would have been thought that in view of the importance of keeping the engine going the aviator would make sure that he had an ample supply of petrol before starting, but M. de Rue apparently overlooked the point. After making three ineffectual attempts to rise he at length got going, but it was only for a minute or two when suddenly the motor stopped and the machine came with undue haste to earth. On investigation it was found that the petrol tank was dry. The aeroplane was slightly damaged and will be repaired immediately. Doubtless in future M. de Rue will take care to see that his petrol tank is well supplied.

Wright Brothers at Fort Myer.

On Tuesday last Orville Wright made several unsuccessful attempts at long-distance flights, in connection with the tests which are required by the U.S. Government before purchasing the Wright flyer. In the afternoon he started from the derrick, but only travelled about 100 yds. when the machine glided to earth, and a second trial ended in the same way. After looking over the machine and making adjustments, it was started again, but this time never left the ground. Operations then ceased for the day, and it was not until nearly seven on Wednesday evening that the machine was brought out again. Orville once more took the pilot's seat, and although at first it appeared that he had got away all right, after about 400 yards the flyer suddenly tipped and glided at an acute angle to the ground from a height of about 20 ft. As a result of the sudden landing, one of the runners was injured, and the brothers, after conferring together, decided that they would not make any further attempts to fly that day.

Flying Experiments in Canada.

Dr. Graham Bell is at present at the Canadian Artillery Camp at Petewawa, Ontario, and with his assistants, Mr. McCurdy and Mr. Baldwin, are carrying out a series of tests with a flying machine of his design.

Munificent Help for Aviation in France.

The substantial encouragement, in the way of funds, with which the cause of aviation in France is favoured is astonishing. A fortnight ago we announced that one of the most valuable prizes which France has to offer had been awarded to Messrs. Voisin and Bleriot for their valuable work in the development of heavier-than-air flying machines, and now we have to chronicle two munificent gifts which have been made with a view to assisting in the study on the subject of flying. M. Henry Deutsch de la Meurthe, who has all along proved such a staunch friend of aviators, has once more come forward, this time offering a sum of 500,000 frs. (£20,000), together with an annual subsidy of 15,000 frs. (£600), for the foundation of an aero-technical institute in connection with the Paris University, for the pursuance of study and research tending to the perfection of flying machines of all types. This will be known as the "Fondation Henry Deutsch."

As the whole of the capital sum will hardly be required for the building and equipment of the Institute, there should be ample funds for carrying it on, but that there may be no doubt the Council of the University have decided to vote an annual grant of 10,000 frs. (£400), making the total annual amount 25,000 frs. (£1,000).

M. Basil Zakaroff, a wealthy Greek, who has lived in Paris for many years, is the donor of the second gift, which is of a value of 700,000 frs. (£28,000) to be utilised for the foundation of a chair of aviation by the Faculty of Science at the Paris University. This will be known as the "Fondation Basil Zakaroff."

Needless to say, both gifts have been readily accepted, and the donors most heartily thanked for them.

Aerodrome for Capt. Gerardville.

With the object of securing a special and up-to-date attraction, the authorities of the popular seaside resort of Dinard are negotiating with Capt. Gerardville, one of the three Wright pupils, to make flights over the Bois-Thomelin race-course. It is proposed to make the race-course suitable for the purpose, and to enter into a three years' contract with Capt. Gerardville, who, in return for an annual payment of 10,000 frs., shall make flights on his Wright flyer every day during the season. The aviator has designed, in conjunction with M. Charpentier, a system of floats to allow his flyer to rise from, and come to rest upon, the water, as he intends to attempt some flights across the bay from Dinard to St. Malo and Paramé.

A.C.F. Aerodrome.

For some time the Automobile Club of France have been making arrangements for the establishment of a large aerodrome in the neighbourhood of Paris, and although the definite location of the ground has not been published officially yet, it will probably be found that it is close to Lieusaint, about 30 kiloms. from the French

capital, where a large piece of land, 800 hectares in extent, has just been sold. Three big farmhouses are on the estate, which is adjacent to the Paris, Lyons, and Mediterranean Railway.

An Aviation Meeting for Charity.

With a view to assisting the fund which has been started for the relief of sufferers by the Midi earthquake, the Ligue Nationale are organising a meeting to be held at Juvisy to-morrow (Sunday), at which they are offering the prize of 1,000 francs presented by Mme. Edmond Archdeacon. This prize will be awarded to the machine which, on the day in question, flies for the longest distance in a closed circuit.

The "Daily Mail" Dirigible Garage.

Work has already been begun upon the garage which the *Daily Mail* is building to house the Clement-Bayard airship when it visits these shores in August or September. At the end of last week the War Office consented to the erection of the shed upon Government land at Wormwood Scrubbs, almost next door to the Clement-Talbot works, and on Monday the designs were submitted by Mr. H. O. Ellis, the architect, to General Rainsford-Hannay of the War Office, and approved. They were immediately sent on to Messrs. Richard Moreland and Sons, the contractors, and on Tuesday morning a staff of about 200 men, working in three shifts, commenced the work of construction. The frame of the huge building will be made in sections, and will be ready for erection at the end of this month. Altogether about 400 tons of wrought-steel work, and 65 tons of corrugated iron, all of British manufacture, will be used in the construction of the shed, which is to be completed by the end of August. It will not be cork-lined, and one end will be open, wind and rain being kept out by two huge curtains of sail cloth.

Dirigibles and Abandoned Coastguard Stations.

In the House of Commons on Monday, Mr. Fell asked the first Lord of the Admiralty if he would refrain from parting with any coastguard stations or Government land round the East Coast until he had ascertained that they could not possibly be required in the near future for the erection of garages for dirigible balloons or aeroplanes, and that the buildings would not be of advantage for the accommodation of the men in charge of them.

In reply Mr. McKenna stated that the value of any land and buildings which at present may be the property of the Admiralty would be fully considered before they are parted with. The Admiralty would not lose sight of the very important point raised by the hon. member.

"Zeppelin I" Marooned.

On Monday at midnight, "Zeppelin I" was brought out of the shed at Friedrichshafen and soon after was despatched on her way to take up her station at Metz. The crew consisted of seven men, the commander being Capt. Sperling. Only a light wind was blowing when the voyage started, but soon after rain fell heavily and the wind became so strong that it was decided to bring the airship down at Biberach in Wurtemburg, about 34 miles north of the starting place. A large quantity of gas had escaped and fresh supplies were telegraphed for, as well as mechanics to make adjustments to the motors, &c. All day on Wednesday the heavy rains and violent squalls of wind prevented the airship from being moved, and the soldiers who were brought from Ulm to mount guard over it had a very dreary and anxious time. At the time of going to press the craft was still weather-bound.

"Parseval III" Takes the Air.

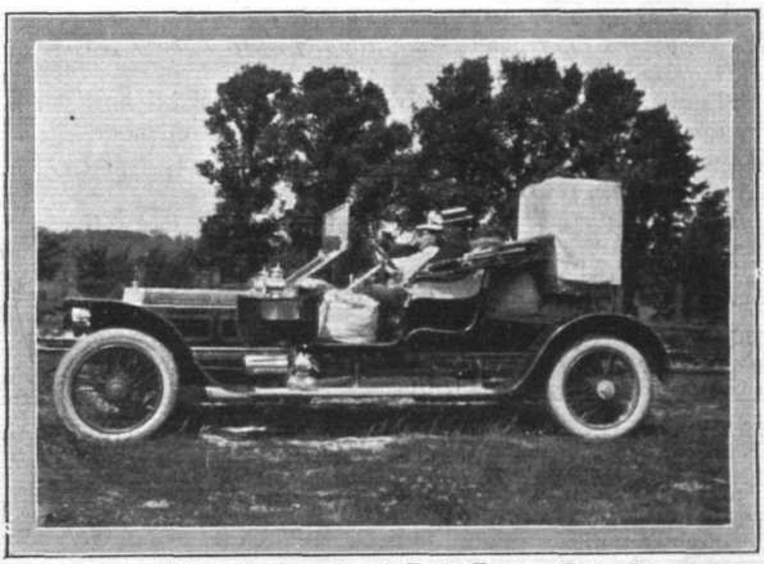
Germany's latest dirigible, "Parseval III," made its maiden voyage on Monday last, covering a distance of about 25 miles from Bitterfeld against a fairly strong southerly wind. The average altitude was about 675 ft., and apparently all the mechanism, steering arrangements, &c., of the airship worked perfectly. In a few days' time it is proposed to send the airship to Frankfort, where it is to make flights, carrying about half-a-dozen passengers in connection with the Aeronautical Exhibition there.

"Ville de Nancy" has a Trial Trip.

While President Fallières was watching the race for the Grand Prix, at Longchamps on Sunday, a dirigible appeared overhead. It was the "Ville de Nancy," a vessel which has been built on almost exactly similar lines to the "Clement-Bayard I." It had sailed from Sartrouville under the command of M. Kapferer, and altogether the trip lasted about one hour, during which the vessel attained a speed of about forty miles an hour. As soon as one or two trifling adjustments have been made by M. Kapferer, he intends to take the "Ville de Nancy" to the city from which she derives her name.

Belgian Dirigible.

On Sunday last, at the Boisfort aeronautic park near Brussels, in spite of the heavy rain, M. Robert Goldschmidt made the first trial of the Belgian dirigible "Belgique," which has been designed by M. Louis Godard. It remained in the air for some 36 mins., during which it described two circles about 4 kiloms. in diameter at a height of 300 metres. It maintained perfect stability during the trip and landed within 100 yards of its shed. Two motors of Pipe manufacture are fitted, each giving 145-h.p. and weighing 290 kilogs.



Boxing an "Imp" on a 6-cyl. Rolls-Royce Car.—So compact and "mobile" is the "Imp," the miniature balloon of the Hon. C. S. Rolls, that he is in the habit of transporting it on his R.R. car, as seen above. This photo was taken upon an occasion shortly after the balloon had made a trip of several hours, when Mr. Short, of the well-known firm of Short Bros., the makers of the Wright flyers in this country, who is in the car with Mr. Rolls' driver, packed up the tiny spherical and returned to town in record time.

AERO CLUB OF THE UNITED KINGDOM.

OFFICIAL NOTICES TO MEMBERS.

Fixtures for 1909.

July 10 ...	Balloon Race, Hurlingham Club (Challenge Cup presented by Mr. F. Hedges Butler).
July 17 ...	"Hare and Hounds" Balloon Race, Hurlingham Club (Cup presented by the Hon. C. S. Rolls).
August 28 ...	Gordon-Bennett Aviation Cup, Rheims.
October 3 ...	Gordon-Bennett Balloon Race, Zurich.

Committee Meeting.

A meeting of the Committee was held on Tuesday, June 29th, 1909, when there were present: Mr. Roger W. Wallace, K.C., in the chair, Mr. Griffith Brewer, Mr. Ernest C. Bucknall, Prof. A. K. Huntington, Mr. V. Ker-Seymer, Mr. F. K. McClean, Mr. J. T. C. Moore-Brabazon, Mr. C. F. Pollock, Hon. C. S. Rolls, Mr. Stanley Spooner, H. E. Perrin (Secretary).

New Members.—The following new Members were elected:—

A. Bennett.	Cecil Grace.
A. E. Bradshaw.	Philip Grace.
Col. Browne.	Visct. Massereene and Ferrard.
Lieut. A. Trevor Dawson, R.N.	F. Sanders Morris.

Rheims Week.

The programme arranged for the Rheims week appeared in last week's FLIGHT.

The rules governing the various competitions can be had on application to the Secretary of the Aero Club. Entries close on July 22nd.

The Aero Club have entered for the Gordon-Bennett Aviation Cup, which takes place on Saturday, August 28th, and many members have already arranged to be present for the Rheims week.

Balloon Race at Hurlingham.

The race for the Hedges Butler Challenge Cup will take place at Hurlingham Club, Fulham, S.W., on Saturday, July 10th, 1909, at 3.30 p.m. Members desiring to compete are requested to advise the Secretary not later than 5 p.m. on Wednesday, July 7th, 1909. Entrance fee, 10*s*.

Members of the Aero Club will be admitted to the Hurlingham Club free on presentation of their Aero Club Membership Cards.

Members of the Aero Club can obtain special tickets for the admission of their friends, who are not members of the Aero Club, to Hurlingham, from the Secretary of the Aero Club, price 10*s*. each.

The rules governing the competition appeared in last week's FLIGHT.

The Club balloon, "Aero Club IV," will follow the race. Members wishing to make the ascent are requested to notify the Secretary at once. The fee will be £5 per person, and the three seats available will be allotted in order of application.

Mortimer Singer Plate. Presented by Mr. A. Mortimer Singer.

1. The Prize must be competed for during the months of July, August, and September, 1909.

2. The Prize will be awarded to the competitor who, in a single trip, covers the greatest distance. Such competitor need not be the aeronaut in charge, but must make the ascent.

3. The distance must be covered in Great Britain only, *i.e.*, the crossing of the open sea (*e.g.*, the English Channel, Irish Sea, &c.), will not be permitted; this, however, need not be taken to apply to indentations in the British coast, such as the mouth of a river, &c.

4. To prevent competitors landing too near the sea, the distance will be measured only up to within 5 miles from the point at which their line of direction permanently leaves the British coast.

5. The prize will be open to members of the Aero Club only, who must not be accompanied by a professional aeronaut.

6. Ordinary balloons (irrespective of size) only must be used, inflated with ordinary lighting gas.

7. A competing balloon must be in charge of a member possessing the Club aeronaut's certificate, or a member who has made at least twelve ascents.

8. Entry must be made by the competitor by letter or telegram addressed to the Secretary, before starting; such entry must state name of balloon, place of ascent, and approximate time of departure. One person only can compete in the same balloon at the same time. The entrance fee for each ascent is 5*s*.

9. A proper anchor and trail rope must be taken, and may not be dispensed with at any time.

10. Competitors are required on landing to properly fill in a landing certificate, which must be obtained from the Secretary beforehand, and this certificate should contain such full particulars as will enable the Committee to easily locate on an ordnance map of half-an-inch to a mile the exact point at which the descent was made. These particulars must include the following details:—

Name of competitor.	Name of parish.
Name of aeronaut in charge.	Name of property and owner thereof.
Name of balloon and capacity.	Name and distance of nearest village.
Number of occupants.	Name and distance of nearest railway station.
Names of passengers.	Name and distance of nearest telegraph office.
Place of ascent.	Name and distance of nearest town.
Date and time of ascent.	
Date and time of descent.	

The landing certificate must be signed as correct by the competitor and others (if any) accompanying him, and two responsible persons present at the place of descent, and must be sent in to the Secretary within seven days.

11. No descent must be made during the run for the purpose of putting out or changing, temporarily or permanently, a passenger or passengers, or for taking in ballast or gas. Once a descent is made, the distance, for the purpose of the competition, can only count up to the point at which such first descent is made.

12. Competing aerostats may not be dragged except at the final descent for convenience in packing; in the latter case the distance for the purpose of the competition will be measured only up to the point at which such dragging commenced.

13. Competitors, by entering, agree to be bound by these rules, and a competitor who does not strictly comply with the rules will be liable to disqualification.

14. The decision of the Committee of the Aero Club of the United Kingdom, in all matters of dispute, or as to the interpretation of the rules, will be final.

Sailor-Aeronaut Race.

Although the weather on Saturday last was unfavourable, a large number of members accepted the kind hospitality of the Motor Yacht Club at the "Enchantress." Fourteen entries were received for the prizes offered by Mrs. Griffith Brewer and Mr. F. H. Butler. The following competed in the final:—

Mr. J. S. Mallam, with Mr. T. Sopwith as crew.
Mr. E. H. Clift, with Vice-Admiral Sir Charles Campbell as crew.
Mr. F. P. Armstrong, with Mr. Slade Olver as crew.
The Earl of Hardwicke, with Mr. L. R. L. Squire as crew.

The final result was as follows:—

First prize—J. S. Mallam, with T. Sopwith as crew.
2nd prize—E. H. Clift, with Vice-Admiral Sir C. Campbell as crew.

Monthly Dinner.

The monthly dinner will take place on Tuesday next, July 6th, 1909, at the Hotel Chatham, Regent Street, S.W., at 8 p.m. (5*s*. 6*d*. each). Members wishing to attend are requested to notify the Secretary not least than Monday, July 5th, 1909. Evening dress optional.

Balloon Ascent.

Saturday, June 26th, "Satellite." A. M. Singer and Hon. C. S. Rolls.

HAROLD E. PERRIN, Secretary.

166, Piccadilly, W.

SAILOR-AERONAUT RACE.

FOR the second annual sailing race between members of the Aero Club and the Motor Yacht Club on Saturday last, the entries were so numerous that five preliminary heats were necessary. For the final, the four one-design sailing boats were manned by Mr. J. S. Mallam, with Mr. T. Sopwith as crew; Mr. E. H. Clift, with Vice-Admiral Sir Charles Campbell; Mr. F. P. Armstrong, with Mr. Slade Olver; and the Earl of Hardwicke, with Mr. L. R. L. Squire. At gun-fire all the boats got smartly away, Mr. Mallam securing a slight advantage, and this he maintained to the end, with Mr. Clift close behind, the Earl of Hardwicke being in the third position.

This race was suggested last year by Mr. Griffith Brewer, in view of the fact that a knowledge of seamanship was of great utility to aeronauts and aviators, and in order to start the race Mrs. Griffith Brewer offered a prize of £10. The conditions were accepted by both the M.Y.C. and the Aero Club, and the race was well supported last year. This year, as we have mentioned above, the entries were so numerous that five preliminary rounds were necessary, and in view of the popularity of the fixture the "field" promises to be even larger next year. For 1909 Mrs. Griffith Brewer again gave a £10 prize for the winner, which was supplemented by a prize of £5 from Mr. Hedges Butler for second place.

AERIAL HONEYMOONS.

OF course, it was bound to come. The craze for doing something out of the ordinary, which is such a strong characteristic of the inhabitants of New York, would surely demand that someone would want to be married in mid-air. Mr. Roger Burnham and Miss Eleanor Waring set their hearts upon having the nuptial knot tied while suspended in space, but they could not find a clergyman who would consent to perform the ceremony under such unique conditions. They therefore decided to do the next best thing, and that was to have a balloon honeymoon. After being married at Cape Cod, they ascended in the balloon "Heart of the Berkshires," which had been provisioned for a two-days' journey among the clouds. The honeymoon was not of long duration, however, only lasting for 3h. 50m., the balloon descending at Holbrook, Mass., not far from Boston Harbour, after a trip of 175 miles, during which an altitude of 4,500 ft. was reached. The landing was effected in an orchard, and was made with "not even a jar," but whether it is the family variety that is referred to is not clear. Anyway, the bride and bridegroom had an exciting time among the branches of an apple tree.

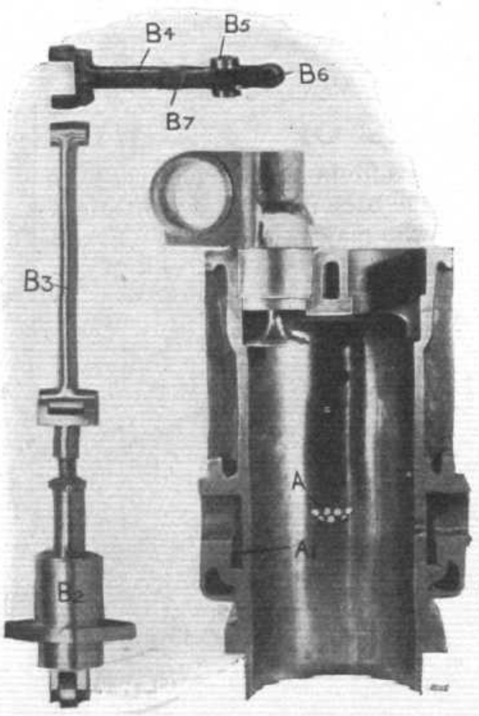
CORRESPONDENCE.

*** *The name and address of the writer (not necessarily for publication)* MUST *in all cases accompany letters intended for insertion, or containing queries.*

AERONAUTICAL ENGINES.

To the Editor of FLIGHT.

SIR,—Having for some time now manufactured and supplied engines with auxiliary ports, we should like to point out that if the



On the left, sectional model of the cylinder, showing auxiliary exhaust-ports, A, which on the right are seen in an external view of the cylinder-casting.

piston is designed of a greater length than the stroke, as in our engines, the exhaust ports are never uncovered from below, therefore it is impossible for the oil in the crank-chamber to be blown out. Also if care is taken to calculate the correct area of the exhaust port, which in our case is equivalent to a rectangular slot 5 ins. by ½ in. on a 4¾-in. stroke engine, it is quite unnecessary to fit a non-return valve.

The chief difficulty with auxiliary exhaust ports is that unless means are taken to prevent it, the heat transferred from the top of the cylinder to the base raises the temperature of the crank-case, and incidentally the bearings as well.

We should be very pleased to show Mr. McKinney, or any of your readers who are interested in auxiliary exhaust, how marvellously cool an engine so fitted will work and maintain its revolutions at full load hour after hour on the test bench.

A section of this cylinder was shown in your contemporary, the *Automotor Journal*, April 25th, 1908, pp. 545 and 546. Perhaps you might think them of sufficient interest to reproduce with this letter.

Yours faithfully,
AEROPLANE ENGINE CO., LTD.,
26th June. W. L. ADAMS, Managing Director.

[The illustrations referred to are given herewith.—ED.]

LANGLEY *v.* LANCHESTER.

To the Editor of FLIGHT.

SIR,—With reference to your article, Langley *v.* Lanchester, in answer to my letter in the same issue of FLIGHT, I am quite surprised that my letter has been so misunderstood, consequently I will try and put it more to the point. Langley says:—

1. The resistance due to skin-friction is so small that it can be neglected, in comparison to the dynamic resistance for all speeds and angles he had experimented with.

2. That any space-occupying part of a flying machine could be given such a form that it need not oppose any other than *frictional resistance.*

By reading 1 and 2 no one can be in doubt as to what Professor Langley means, and my contention is that Mr. Lanchester has created a wrong impression on Professor Langley's memos, by only quoting some few sentences, which are apt to be misleading when taken separately.

Furthermore, your remarks, "If the skin-friction is negligible then it must be negligible at all speeds," leads me to believe that there is a mutual disagreement in regard to the meaning of the word "negligible," and I will endeavour to explain what I understand by the word.

As the dynamic resistance for a constant load per unit of area is diminishing with increased speed, and the frictional resistance is increasing, we have for small velocities big dynamic resistance and small frictional resistance, and the converse at high velocities.

Now, I contend that as long as the frictional resistance is only a few per cent. of the dynamic the former can be neglected, but so soon as this reaches an appreciable amount (say 10 per cent. of the dynamic resistance) it has to be taken into consideration. However, this does not take place inside the speed limits of Professor Langley's experiments.

Truly yours,
F. G. NYBORG.

PROPELLER CHALLENGE.

To the Editor of FLIGHT.

SIR,—I have no desire to disappoint Mr. Walker in the competition. I furnished certain particulars of the motor in my last letter, certified by one who tested it for me; they were, however, not published*. I now give Mr. Walker some details of my experiments, which may help him to design a suitable propeller to run with the motor. It is rated at $\frac{1}{8}$-h.p.; speed, when running light, 2,000 r.p.m. on 200 volts. I get a direct lift of over 4 lbs., and keep the weight suspended on one amp. at 970 r.p.m., with a propeller complete with boss weighing 5$\frac{3}{4}$ ozs. If Mr. Walker will tell me the actual thrust he gets with his 3-ft. propeller, and at what speed, I may send one to be tested, but it must weigh 2 lbs. My propellers are so designed that they automatically adjust their pitch, and give the best thrust according to the conditions under which they are working. I get better results from a propeller with a varying pitch than one with a fixed pitch. Referring to Mr. Wildey's acceptance, if he will fit one of his fans on my motor weighing under 6 ozs. complete with boss, the boss to be solid $\frac{3}{8}$ in. in diameter, and $\frac{3}{4}$ in. long on one side of the fan, to fit into a female coupling on the motor, and arranges to bring it to 26, Clarges Street, W., if his fan gives a better lift than my propeller he has earned my £5.

Yours faithfully,
WILLIAM COCHRANE.

P.S.—My propeller, like Mr. Walker's, revolves in a left-handed direction, as viewed from behind.

*[The figures to which Mr. Cochrane refers as having been given in his last letter were not reproduced because the form in which they were given relatively to the text did not make them sufficiently clear. In fact, we were not certain, from the way in which they appeared on the paper, whether they were intended for publication or had merely been employed for private calculations.—ED.]

To the Editor of FLIGHT.

SIR,—I note that I am not alone in taking exception to the very inadequate particulars furnished by Mr. Cochrane, and for that reason alone there seems little likelihood of anyone "lifting his siller." No sane person will enter a competition in the dark.

If anyone should happen to take it on, however, I would readily run my propeller against that competitor's after he has beaten the "Cochrane."

Yours faithfully,
SIDNEY H. HOLLANDS.

EXPERIMENTAL FLIGHT GROUNDS WANTED.

To the Editor of FLIGHT.

SIR,—We have heard a good deal about England's backwardness, as compared with our neighbouring countries, in aerial navigation, but few people have any idea of the difficulties the English pioneer has to fight against.

The ground I am at present experimenting on is quite suitable for short flights, but for manœuvring there are too many stumps (which are not to be moved) to dodge, consequently my machine has been badly damaged on two occasions through running into them.

In France, all the aeroplane builders of note live in or near Paris, where they have an excellent smooth and large open space at Issy to carry out their first trials. In this matter England is not unlike France, for the chief aeroplane builders live in or near London.

We have the grounds, namely, Wimbledon, Hackney Marshes, and Wormwood Scrubs. Why cannot serious steps be taken to allow aeroplanists to practice on one of more of these grounds? They are practically deserted twenty-three out of twenty-four hours. It is for the nation's good we should keep abreast of the times. Should such a thing as a harmless cyclist ride across the latter three grounds he is immediately followed by one or more keepers shouting and frantically waving their arms. The sooner England slackens off some of its red tape the better it will be for the country at large.

If we are to excel our foreign rivals in aeroplaning, and there is no reason why we should not, then every encouragement should be given to the British pioneer.

Yours faithfully,
A. V. ROE.

GEARS FOR FLAPPING FLIGHT.

To the Editor of FLIGHT.

SIR,—In the description of my gear for flapping flight in your issue of June 19th, you state that it does not include any mechanism for feathering the wing on the up-stroke. From practical experiments which I have made with wings similar to the one illustrated in the article, I find that if the wing is made with a certain degree of flexibility, on the up-stroke it will flex down at an angle to the plane of the machine and give a most efficient propelling-stroke; on the down-stroke the concave part of the wing gives a powerful lifting effort to the machine, and the extreme tip flexes upwards and gives a powerful forward thrust. Since I exhibited the gear at Olympia, I have improved and simplified it very considerably.

Yours faithfully,
WILLIAM COCHRANE.

INFORMATION WANTED.

To the Editor of FLIGHT.

SIR,—May I trespass upon your space to inquire if any of your readers can inform me of the address of Messrs. Fiscators, Ltd., makers of accessories for aeroplanes, also whether the Hollands propeller is yet actually on the market, and, if so, whether the address of the manufacturers can be given?

Yours faithfully,
ALFRED B. E. CHEESEMAN.

ANSWERS TO CORRESPONDENTS.

R. Hickman.—We have an article in hand specially dealing with the precise question which you ask, but in the meantime we should like to refer you specially to some other articles if you will forward us your address.

NEW COMPANIES REGISTERED.

Aeronautical Syndicate, Ltd., 30, Moorgate Street, E.C.—Capital £2,500, in £1 shares.

Handley Page, Ltd., 36, William Street, Woolwich, Kent.—Capital £10,000, in £20 shares. Manufacturers of and dealers in aeroplanes, hydroplanes, &c. First directors, H. Page and F. N. Dalton.

Aeronautical Patents Published.

Applied for in 1908.

Published July 1st, 1909.

12,247. A. CLEMENT. Dirigible balloon.
21,489. E. AND R. PENKALA. Apparatus for rising and travelling in the air.
26,617. G. BEILHARZ. Aerial machines.

Applied for in 1909.

Published July 1st, 1909.

2,111. H. C. LOBNITZ. Aerial machines.
2,741. A. TRIBELHORN. Airships.

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